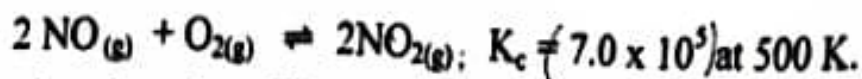
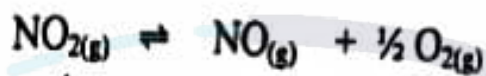


1. Consider the equilibrium reaction:



Calculate the value of K_c for the following equilibrium:



- a) 3.8×10^{-4} b) 1.2×10^{-3} c) 2.0×10^{-3}
d) 4.3×10^{-5} e) 6.2×10^{-4}

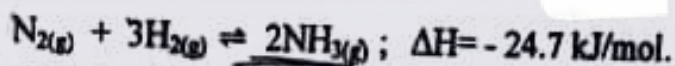
2. Consider the following reaction



Calculate the value of K_p for same reaction at 992 K.

- a) 7.5×10^{-4} b) 1.2×10^{-4} c) 5.8×10^{-4}
d) 4.6×10^{-4} e) 9.0×10^{-4}

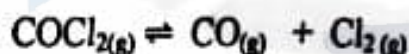
3. Consider the equilibrium reaction:



Which of the following effects will increase the amount of NH_3 at equilibrium?

- a) Increase the temperature.
b) Decrease the concentration of N_2 .
c) Add a catalyst.
d) Decrease the total volume of reaction mixture.
e) Add an inert gas, at same total volume.

4. Consider the following equilibrium at 1320 K:

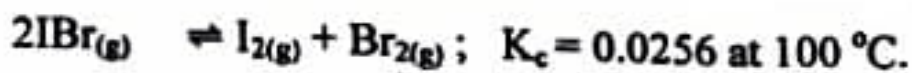


When a sample of 0.600 moles of $\text{COCl}_{2(g)}$ is placed in a 1.00 L container and the reaction is allowed to reach equilibrium. The equilibrium concentration of CO was 0.059 M.

Calculate equilibrium constant K_c for the reaction:

- a) 6.4×10^{-3} b) 5.4×10^{-3} c) 9.0×10^{-3}
d) 3.7×10^{-3} e) 7.2×10^{-3}

5. Consider the following equilibrium:

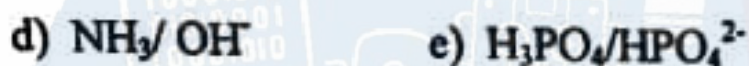
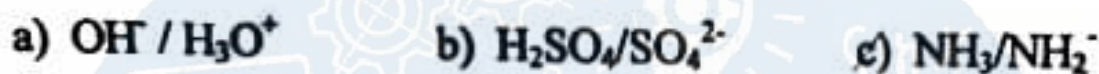


If 1.00 mole of IBr is placed into a 4.00 L vessel at 100 °C and the reaction is allowed to reach equilibrium.

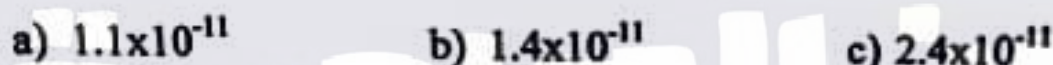
Calculate the molar concentration of Br₂ at equilibrium.

- a) 0.076 b) 0.061 c) 0.024 d) 0.048 e) 0.030

6. Which one of the following would be a conjugate acid - base pair?



7. Calculate the molar concentration of H⁺ in a 0.20 M aqueous solution of hydrazine. Hydrazine, N₂H₄, is a weak base, K_b = 1.7 × 10⁻⁶.



8. A weak acid is 8.00 % ionized in 0.0200M aqueous solution of the acid at 25°C. Calculate pK_a for the acid.

- a) 4.24 b) 3.56 c) 3.38 d) 3.16 e) 3.86

9. Calculate the pH of 0.40 M aqueous solution of the diprotic acid H₂A. For H₂A: K_{a1} = 2.6 × 10⁻⁵ and K_{a2} = 4.8 × 10⁻¹².

- a) 2.49 b) 2.44 c) 2.82 d) 2.55 e) 2.64

10. Calculate the pH of 0.65 M aqueous solution of ammonium nitrate, NH_4NO_3 . $K_b(\text{NH}_3) = 1.8 \times 10^{-5}$.

- a) 4.66 **b) 4.72** c) 4.80 d) 4.93 e) 5.14

11. Which of the following aqueous buffer solutions has the highest buffer capacity?

- a) 0.10 M NH_3 / 0.10 M NH_4Cl .
b) 0.10 M NH_3 / 0.50 M NH_4Cl .
c) 0.50 M NH_3 / 0.50 M NH_4Cl .
d) 0.50 M NH_3 / 0.10 M NH_4Cl .
e) 0.010 M NH_3 / 0.010 M NH_4Cl .

12. Calculate the pH of a buffer prepared by mixing 500.0 mL of 0.20 M aqueous solution of HF and 500.0 mL of 0.40 M aqueous solution NaF. $K_a(\text{HF}) = 6.8 \times 10^{-4}$.

- a) 8.43 b) 3.77 c) 2.87 d) 3.47 e) 2.57

13. Calculate the change in pH when 0.03 mol HCl are added to 1.00 L buffer solution that contains 0.60 mol NH_3 and 0.70 mol NH_4Cl . Assume no volume change. $K_b(\text{NH}_3) = 1.8 \times 10^{-5}$.

- a) Decrease by 0.04 b) Decrease by 0.08 c) Increase by 0.04
d) Increase by 0.04 e) No change in pH.

14. Which one of the following changes would have negative ΔS sign?

- a) $\text{H}_2\text{O}_{(l)} \rightarrow \text{H}_2\text{O}_{(g)}$
- b) Dissolving glucose in water.
- c) $2\text{CH}_3\text{OH}_{(l)} + 3\text{O}_{2(g)} \rightarrow 2\text{CO}_{2(g)} + 4\text{H}_2\text{O}_{(l)}$
- d) $\text{CS}_{2(l)} + 2\text{H}_2\text{O}_{(l)} \rightarrow \text{CO}_{2(g)} + 2\text{H}_2\text{S}_{(g)}$
- e) $\text{H}_2\text{O}_{(l)} \text{ at } 25^\circ\text{C} \rightarrow \text{H}_2\text{O}_{(l)} \text{ at } 75^\circ\text{C}$

15. Given the following data:

	ΔH_f° (kJ/mol)	S° (J/mol.K)
$\text{CH}_3\text{OH}_{(l)}$	-259	127
$\text{H}_2\text{O}_{(l)}$	-286	70.0
$\text{CO}_{2(g)}$	-394	214
$\text{O}_{2(g)}$	—	205

Calculate ΔG° (in kJ/mol) for the following reaction at 25°C .



- a) - 703
- b) - 693
- c) - 713
- d) - 813
- e) - 683

16. Consider the following reaction:



$\Delta H^\circ = +109 \text{ kJ/mol}$ and $\Delta S^\circ +137 \text{ J/mol.K}$.

Which of the following statements is correct?

- a) The reaction is spontaneous at all temperatures.
- b) The reaction is spontaneous at temperature higher than 550°C .
- c) The reaction is non-spontaneous at all temperatures.
- d) The reaction is spontaneous at temperature between $100-500^\circ\text{C}$.
- e) The reaction is spontaneous at temperature less than 100°C .

17. Consider the reaction:

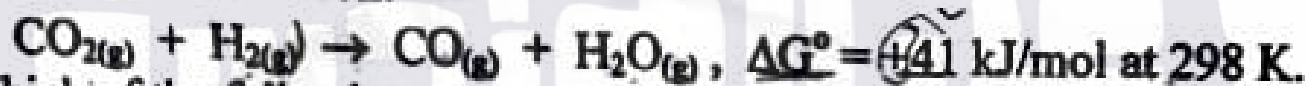


$\Delta H^\circ = 278 \text{ kJ/mol}$ and $\Delta S^\circ = 31.9 \text{ J/mol.K}$.

At 127.0°C , K_p for the reaction is about:

- a) 2×10^{-35} b) 9×10^{-34} c) 4×10^{-33}
d) 7×10^{-32} e) 1×10^{-36}

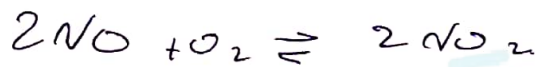
18. Consider the reaction:



Which of the following statements is true about the reaction?

- a) The reaction is spontaneous under standard conditions.
b) The reaction is spontaneous under all partial pressures of reactants and products.
c) The reaction is non-spontaneous under all partial pressures of reactants and products.
d) The reaction could be spontaneous if Q_p (reaction quotient) is 10^{-10} .
e) Equilibrium constant for the reaction is greater than 1.00.

Q1: answer is (b)



1) reverse $\Rightarrow 2\text{NO}_2 \rightleftharpoons 2\text{NO} + \text{O}_2 \Rightarrow \frac{1}{K_c} = \frac{1}{7 \times 10^5} = 1.43 \times 10^{-5}$

2) reduce by $\frac{1}{2} \Rightarrow \text{NO}_2 \rightleftharpoons \text{NO} + \frac{1}{2}\text{O}_2 \Rightarrow \sqrt{K_c} = \sqrt{1.43 \times 10^5}$
 $= 1.195 \times 10^3 = 1.2 \times 10^3 \checkmark$

Q2: answer is (C)

$$K_p = K_c (RT)^{\Delta n}$$

$$K_c = 0.0472$$

$$R = 0.082$$

$$\Gamma = 992$$

$$\Delta n = 2 - 3 = -1$$

$$K_p = 0.0472 (-0.0821 \times 992)^{-1}$$

$$K_p = 5.795 \times 10^{-4} \approx 5.8 \times 10^{-4} \checkmark$$

Q3: answer is (b)

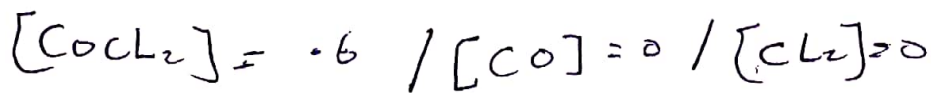
\downarrow conc N_2 , \downarrow P, \uparrow V \Rightarrow \uparrow in product

T \Rightarrow change k

catalyst \Rightarrow no effect

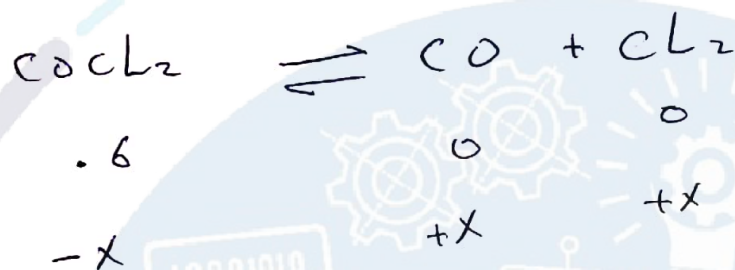
Q4) answer is (a) :-

Initial concentration :-



$$[\text{CoCl}_2] = \frac{-.6}{1} = -.6$$

Find Intermediat :-



Find concentration :-

$$[\text{CoCl}_2] = .6 - x \quad , \quad [\text{CO}] = x \quad , \quad [\text{Cl}_2] = x$$

but $[\text{CO}] = .059$ so $\Rightarrow x = .059$.

$$\Rightarrow [\text{CoCl}_2] = .6 - .059 = .541$$

$$\Rightarrow [\text{CO}] = .059$$

$$\Rightarrow [\text{Cl}_2] = .059$$

$$K_c = \frac{[\text{CO}][\text{Cl}_2]}{[\text{CoCl}_2]} = \frac{(.059)^2}{.541} = 6.43 \times 10^{-3} \checkmark$$

Q5) answer is (e) :-

$$[IBr] = \frac{1}{4} = 0.25$$

Initial conc. :-

$$[IBr] = 0.25, [I_2] = 0, [Br_2] = 0$$

Intermediate :-



0.25	0	0
-2x	+x	+x
0.25 - 2x	x	x

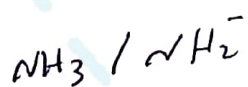
Final conc. :-

$$[IBr] = 0.25 - 2x, [Br_2] = x, [I_2] = x$$

$$K_c = \frac{[I_2][Br_2]}{[IBr]^2}$$

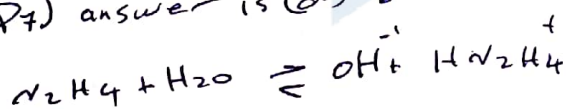
$$0.256 = \frac{x^2}{(0.25 - x)^2} \Rightarrow x = 0.03 = [Br_2]$$

Q6) answer is (c) :-



It reduced the charge and the hydrogen atom from the first

Q7) answer is (d) :-

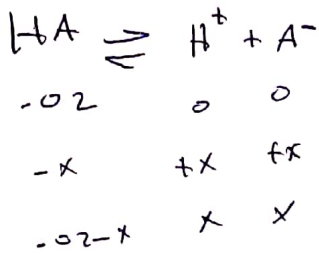


$$K_b = \frac{[OH^-][HN_2H_4^+]}{[N_2H_4]}$$

$$1.6 \times 10^{-6} = \frac{x^2}{(0.2 - x)} \Rightarrow x = 5.827 \times 10^{-4}$$

$$[H^+] = \frac{K_w}{[OH^-]} = \frac{1 \times 10^{-14}}{5.827 \times 10^{-4}} = 1.717 \times 10^{-11} \checkmark$$

Q8) answer is (e) :-

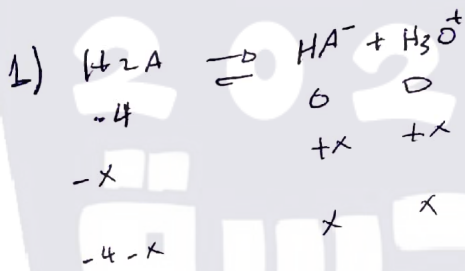


ionization: 8% \rightarrow 0.08
 $x = 0.08 \times 0.2$
 $x = 1.6 \times 10^{-3}$

$$K_a = \frac{x^2}{(0.2-x)} = \frac{(1.6 \times 10^{-3})^2}{0.2 - 1.6 \times 10^{-3}} = 1.39 \times 10^{-4}$$

$$pK_a = -\log(K_a) = 3.856 \approx 3.86 \checkmark$$

Q9) answer is (9) :-

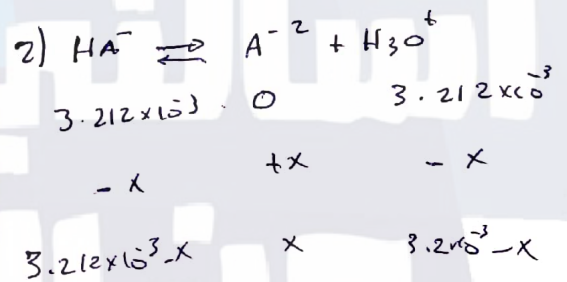


$$K_{a1} = \frac{x^2}{4-x}$$

$$2.6 \times 10^{-5} = \frac{x^2}{4-x} \rightarrow x = 3.212 \times 10^{-3}$$

$x_1 \gg x_2 \rightarrow$ rejected

$$pH = -\log(x_1) = -\log(3.212) = 2.49 \checkmark$$

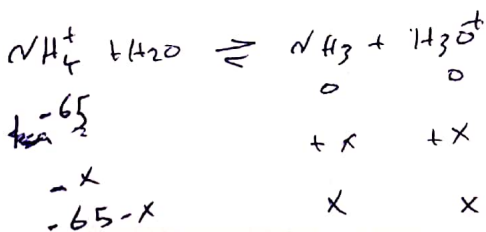
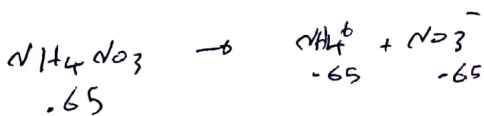


$$K_{a2} = \frac{(3.212 \times 10^{-3} - x) \cdot x}{(3.212 \times 10^{-3} - x)}$$

$$K_{a2} = x$$

$$4.2 \times 10^{-2} = x$$

Q10) answer is (c) :-



$$K_a = \frac{x^2}{.65-x}$$

$$3.85 \times 10^{-10} = \frac{x^2}{.65-x}$$

$$x = 1.58 \times 10^{-5}$$

$$pH = -\log x = 4.8$$

$$K_a = \frac{K_w}{K_b}$$

$$K_a = \frac{1 \times 10^{-14}}{1.8 \times 10^{-5}}$$

$$K_a = 3.85 \times 10^{-10}$$

Q11) answer is (c)

Q12) answer is (d) :-

$$pH = pK_a + \log \frac{[A^-]}{[HA]}$$

$$pH = -\log 6.8 \times 10^{-4} + \log \frac{-2}{-1} \\ = 3.468 \approx 3.47$$

$$1 [H^+] = \frac{500 \times 10^{-3} \times 2}{1000 \times 10^{-3}} = -1$$

$$2 [F^-] = \frac{500 \times 10^{-3} \times 4}{1000 \times 10^{-3}} = -2$$

Q13) answer is (a)

$$pH_1 = pK_b + \log \frac{[salt]}{[base]}$$

$$= -\log 1.8 \times 10^{-5} + \log \frac{-7}{-6} = 4.81$$

$$pH_2 = pK_b + \log \frac{[salt] + [H_3O^+]}{[base] + [H_3O^+]}$$

$$= -\log 1.8 \times 10^{-5} + \log \left[\frac{-7 - 0.3}{-6 + 0.3} \right] = 4.77$$

$$\Delta p = pH_2 - pH_1 = -0.04$$

Q14) answer is (c)

Q15) answer is (e) :-

$$\Delta H_{rxn}^\circ = -394 + 2 \times -286 - \left(\frac{3}{2} \times 0 \right) - (-259) = \frac{-707}{4.92} \text{ kJ/mol}$$

$$\Delta S_{rxn}^\circ = 214 + 2 \times 70 - \left(205 \times \frac{3}{2} + 127 \right) = \frac{-80.5}{-0.805} \text{ J/mol} = -4.92 \text{ kJ/mol}$$

$$\Delta G_{rxn}^\circ = \Delta H - T \Delta S$$

$$-707 - (25 + 273) \times -0.805 = -683 \text{ kJ/mol}$$

Q 16) answer is (b)

$$\Delta H (+) \quad \Delta S (+)$$

is spontaneous at high Temperature

Q 17) answer is (a) :-

K_p so is equilibrium $\Delta G = 0$

$$\Rightarrow \Delta G^\circ = -RT \ln K_p \Rightarrow K_p = e^{\frac{-\Delta G^\circ}{RT}}$$

$$\textcircled{1} \Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$
$$278 - (27+273) \times 31.9 \times 10^3 = -265.24 \text{ kJ/mol}$$

$$K_p = e^{\frac{-\Delta G^\circ}{RT}} = 2.3 \times 10^{-35} \approx 2 \times 10^{-35}$$
$$K_p = e^{\frac{265.24}{3.3256}}$$

Q 18) answer is (c)

good Luck

كالتالي عن الامتحان

اقول الامتحان